Montana
Board of Environmental Review
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BOARD OF ENVIRONMENTAL REVIEW
OF THE STATE OF MONTANA

Minutes of Public Hearings/Meetings on December 1, 2005, in Helena, Montana, to consider the proposed adoption and amendment of rules pertaining to nondegradation requirements for electrical conductivity (EC) and sodium adsorption ratio (SAR) and definitions for technology-based effluent limitations and the adoption of rules pertaining to minimum technology-based controls and treatment requirements for the coal bed methane industry.

Call to Order

Chairman Russell called the public hearing to order at 1:45 p.m., on Thursday, December 1, 2005, in Room 111 of the Metcalf Building, 1520 East Sixth Avenue, Helena, Montana.

Attendance

Board Members Present: Chairman Joseph Russell, Kim Lacey, Bill Rossbach, Robin Shropshire, and Don Marble.

Board members Absent: Gayle Skunkcap

Board Attorney Present: Katherine Orr, Assistant Attorney General, Agency Legal Services Bureau

Board Secretary Present: Joyce Wittenberg

Court Reporter Present: Laurie Crutcher

Department Personnel Present: Richard Opper, Joyce Wittenberg (Board Secretary), Tom Livers (Board Liaison), John North, Art Compton, Bob Bukantis, George Mathieus, Tom Reid, and Christian Levine

Interested Persons Present: See attached sign-in sheets.

Introduction by Chairman Russell

Chairman Russell gave substantially the same introduction as at the hearing/meeting held on November 10, 2005.

Statement of Department of Environmental Quality

Tom Livers gave substantially the same comments as at the hearing/meeting held on November 10, 2005.

Art Compton gave substantially the same comments as at the hearing /meeting held on November 10, 2005.

Proponents

Michael Reisner discussed the factors the BER is required to consider in adopting technology-based control and treatment requirements and identified the experts that would testify on each factor on behalf of the petitioners.

1. Economic Feasibility --- Is it economically feasible to achieve the proposed zero discharge requirement or the end of the pipe treatment limits? Economic feasibility has to be measured across the industry as a whole and it is to be based on the single best performing plant in the industry. The best available technology should represent a commitment of the maximum resources economically possible to move toward achieving the ultimate goal of the Clean Water Act. (Michael Kavanaugh and Jim Kuipers)
2. Technical Feasibility – This involves a consideration of the industrial processes involved and the engineering aspects of the control and treatment technologies. A technology is technically feasible if the best operating facilities can achieve the limitation. (Jim Kuipers and Tom Myers)
3. Non-water quality environmental impacts of the available control and treatment technologies (contamination of native soils and vegetation, reclamation of the contaminated soils, surface disturbance, loss of native vegetation, establishment of noxious weeds, depletion of aquifers and resulting loss of springs and wells). (Jim Kuipers, Tom Myers, Larry Munn and James Bauder)
4. Other factors that are appropriate -- BER's statutory authority and duties under the Montana Constitution, and federal and state Clean Water Acts. (Sarah McMillan)

Sarah McMillan is an attorney with the Tuholske Law Office. She highlighted the three primary sources of the BER's authority to enact the proposed rules. The BER enacted water quality standards two years ago and there was no legal challenge regarding the BER's authority to do so.

The purpose of the federal Clean Water Act is to maintain and enhance the chemical, physical, and biological integrity of the nation's waters. This is achieved by setting water quality standards and effluent limitations reflecting the greatest degree of effluent reduction possible. There is no question that reinjection and treatment are technically feasible. The Clean Water Act specifically gives States authority to enact rules establishing effluent limitations.

The purpose of the Montana Clean Water Act is to conserve water by protecting, maintaining and improving the quality and potability of water for public water supplies, wildlife, fish and aquatic life, agriculture, industry, recreation, and other beneficial uses. It specifically directs the BER to adopt effluent standards and establish standards for new point source discharges. Section 75-5-305, MCA, provides authority for the BER to establish technology-based controls and treatment requirements.

Article 2, Section 3, of the Montana Constitution sets forth the fundamental right to a clean and healthful environment. Article 9, Section 1, sets forth the corresponding duty that the State and individuals maintain and improve a clean and healthful environment. The Supreme Court has indicated that these provisions are intended to prevent damage to the environment and not just to cure damage after it has occurred

The Clean Water Act mandates the treatment of water produced by CBM development according to the best available technology and authorizes the reinjection of CBM discharge water in order to eliminate pollution.

Ms. McMillan submitted her testimony in writing.

Tom Myers is a hydrologist representing NPRC. He has about 25 years experience in academics, government and consulting in the non-profit sector and has spent about a year analyzing the current conditions in the Power River Basin and predicting the future ground water conditions as affected by CBM development.

He showed a slide showing the different basins in the Powder River Basin and the areas where there is the highest potential for CBM development, including current developments and areas that have been leased.

Natural gas methane forms with coal and requires substantial water pressure to be maintained in the coal seam. To develop coal bed methane, the pressure is relieved by removing the water. Most of the water is discharged to surface water, discharged to a land application, or lost to evaporation.

He showed a slide which depicted areas of clinker where groundwater tends to recharge, the Wasatch Formation (less erosive sandstone) and the Fort Union Formation (sandstone, mudstone and coal seams such as the Dietz, Canyon and Monarch formations and the Knobloch Zone). The coal seams are downward trending and are often offset by faults. The coal has fairly low porosity so water flows through it relatively easily. The coal is a major source of water in some parts of the basin.

He assumes that the areas leased for CBM development will be fully developed and will total approximately 1300 square miles and have approximately 25,000 wells. He assumed a 20-year development period and a seven-year life for each well. He also assumed development of the Anderson/Dietz, Canyon and Knobloch coal seams. He showed a slide that depicted the drawdown that he expected to occur after 20 years of development. In some areas the drawdown was 280 feet, with a 100-foot drawdown extending two or three miles beyond the limit of development. The slide also depicted the springs that potentially could be affected by the drawdown.

After development, the water level eventually returns to close to pre-development conditions through recharge. After development, some areas may continue to see a lowering of the water table as groundwater continues to flow into aquifers in the most depleted areas. Thus, springs

that were not affected at the end of CBM development may still be affected. Ninety years after CBM development, there still may be a drawdown of about ten feet in some areas.

Reinjection of developed water into previously depleted coal seams or interburden areas can limit the impacts of CBM development. For his modeling, he assumed 75% of the developed water would be put into depleted coal seams through a phased approach to development. He showed slides that showed recovery of the water level would be much faster with reinjection, reducing the impacts on springs as well.

He also discussed some technical issues regarding reinjection. The pores in the wells may become clogged with sediment, biological growth, gases coming out of solution, and precipitation. This problem may be avoided by filtering or disinfecting the water, minimizing dissolved oxygen in the water, or occasional pumping of the wells.

CBM development may deplete aquifers that are being used for irrigation. In the CX Ranch development area, 10% of the wells are less than 300 feet and 43% are less than 600 feet, substantially overlapping irrigation wells.

The Fort Union sandstone is not amenable to reinjection. Reinjection primary in depleted coal fields requires a phased approached. Reinjection in depleted coalfields may require the water to be piped some distance. Some infrastructure will already be in place that will help facilitate reinjection. Some of the wells used to extract the water may be used for reinjection, although some new wells would have to be drilled. In regard to the waiver, the following information was relevant ---water quality and geochemistry of both the discharge and receiving waters, hydraulic properties of the receiving water, and location of faults and fractures. He gave the following as examples of reinjection, although not all dealt with CBM produced water – sandstone near Denver; CBM water near Gillette; mine dewatering water into a salt formation and reinjection of geothermal water in Nevada.

Reinjection saves a substantial amount of water, substantially reduces the recovery time for water levels, and reuses some of the infrastructure used in producing the gas, reducing surface disturbance

Mr. Myers submitted a paper copy of his power point presentation.

Michael Kavanaugh is an economist. He has assessed NPDES permit compliance across the country, estimating a company's ability to comply and the economic benefits that a company derives from non-compliance.

In determining whether the proposed rulemaking was economically feasible, he asked whether it was capable of being done by the best performing firm in an industry. Feasibility means that the firm can make a normal return on its investment. If a firm asks whether it would complete a project a second time and answers "yes," then the firm has made a normal return.
The discharge limits are economically feasible. The Powder River Basin's wellhead gas prices exceed $3.50 per thousand cubic feet. Some estimate the industry rate of return at 25 to 40% over the life of the field. Injection or treatment before discharge will not reduce energy

production or royalties paid to the State. Additionally, it would not have a material effect on rate of return, reducing it by only one or two percent.

The market cannot be relied on to allocate resources. Water quality is unpriced. Therefore, when an industry impairs water quality by performing an act such extracting CBM, it does not pay the full price of its action. The BER's action can act as a substitute for this market failure of not internalizing all of the costs of methane development.

Mr. Kavanaugh evaluated the effect on CBM development of surface discharge, reinjection and treatment at varying wellhead prices. At a wellhead price of $1.75 per thousand feet, which is very low, the production of gas would decrease if reinjection or treatment were required , resulting in a reduction of royalties or lease payments. He stated, however, that even at $1.75, the CBM developer would be making more than a normal profit. Although there were some resource penalties to be paid, industry could be regulated at $1.75, the penalty paid, and natural gas and water quality preserved.

At a wellhead price of $3.50 per thousand feet, the amount of gas being produced would not change regardless of whether surface discharge, reinjection or treatment were being used. Actually, at about $2.80, the limits to gas extraction are not economic. At the higher price of $3.50 per thousand feet, the CBM developer would be paying about eight or nine cents for injection or treatment per thousand feet. Although the wellhead price has only doubled from $1.75, the Excess Net Present Value (the amount the Net Present Value exceeds zero) has tripled or quadrupled. There is a lot of margin for error in this scenario. Although the rate of return has gone down slightly, the extractor is still going to be well above what it could get for an alternative employment of its resources.

Since 2003, the wellhead price has not even been close to $3.50. The price was $5.39 in July, $12.90 in November. The Annual Energy Outlook for 2005 shows Rocky Mountain prices well in excess of $3.50 throughout its forecast range, which goes to 2030. All of the prices being recorded on the NYMEX between now and 2010 translate in excess of $5.00. The cost of oil is about $55 a barrel. Methane gas having equivalent BTU's would be approximately one-sixth of that figure, exceeding $3.50.

Mr. Kavanaugh submitted his testimony in writing.

James Bauder is a professor and extension soil and water quality specialist at MSU. He is an expert in saline and sodic soil and water management in semi-arid environments.

EC and SAR are harmful parameters. Potential changes in EC and SAR can result in a measurable effect on existing and anticipated uses of the receiving waters and measurable changes in ecological integrity. Managed irrigation using CBM produced water would result in significant increases in EC and SAR in shallow ground water.

In regard to nondegradation criteria applicable to EC and SAR, it is particularly important that the mixing zone function be used and all standards for nondegradation limits be met at the end of the mixing zone. Numeric nondegradation standards are necessary. The criteria should specify

that increases in EC and SAR at the end of the mixing zone should not exceed 10 percent of the established standard and that the existing water quality in the stream should be maintained at less than 40 percent of the established standard. Limits based on 7Q10 flows have proven to be appropriate in defining critical water quality parameters criteria during low flow conditions.

The zero discharge requirement precludes beneficial uses of some methane wastewater. Certain circumstances allow for beneficial use of methane wastewater without treatment and without reinjection (forage enhancement, livestock forage production, rangeland forage production).

The proposed technology-based effluent criteria are unnecessarily low and will result in treatment requirements substantially below that which would be required to match ambient conditions; to achieve in-stream, irrigation season, or instantaneous maximum standards; or comply with nondegradation standards. The proposed numeric standards are inconsistent with the proposed nondegradation standards.

The current standards, when instituted in combination with the non-degradation criteria, are substantially protective of present and projected or anticipated downstream irrigation usage of the Powder, Little Powder and Tongue Rivers. The limits which would be applied to water discharge from treatment facilities could be significantly increased in the event treatment requirements are adopted.

Although reinjection may be technologically feasible, the statistics presented in support of proposal for complete reinjection do not accurately represent conditions within the Powder River Basin.

It is possible for the land application of produced water to elevate the SAR in the soil substantially higher than the SAR of the applied water. Mr. Bauder submitted an executive summary of submitted written comments.

Larry Munn is professor of soil science at the Department of Renewable Resources at the University of Wyoming. The land application disposal systems in the Powder River Basin in Wyoming have resulted in the build up of salts and sodium and reductions in infiltration despite efforts by the companies to properly manage the water. The worst is yet to come. When saline water is no longer applied and the sites receive normal snowmelt and rain, the sites will become sodic.

The federal EIS for gas development indicated that potentially irreversible problems would arise if the soil SAR were above 13. The applied water would have to have an SAR no greater than 8 or 9 so that it would not build up in the soil over time. Wyoming DEQ issued permits allowing 21, 24 SAR water for discharge into streams.

Ephemeral drainages have been transformed to perennial flow, or at least flow in month-long blocks of time resulting in a significant increase is sodicity.
Surface owners have problems with the way Wyoming DEQ administers its program. In the contest of a permit renewal, Wyoming DEQ has shifted the burden to the landowner to prove why a permit should not be renewed with higher SAR and salinity limits and a larger volume of

water. Wyoming DEQ has also indicated that it can only regulate water quality and the water quantity is a civil trespass issue. Wyoming DEQ also states that its regulations only apply to water that passes through a registered irrigation diversion. The regulations do not apply to subirrigation and natural flooding. This covers less than 1 million of 26 million acres classified as agricultural in Wyoming.

Even good quality water in a continuous flow in the wrong location can be problematic. It can interfere with putting up hay and can cause problems when moving livestock. One rancher had to move his cattle on the county road to avoid a wet saturated clay area. He has also lost cottonwood trees because of the saturation.

James Kuipers is the principal of Kuipers and Associates, has extensive experience in environmental permitting, has authored articles on CBM development, and is currently a contractor with the EPA performing studies on water treatment application and cost estimation.

Mr. Kuipers indicated that the waiver provisions of the proposed rulemaking are similar to the waiver provisions that presently exist for nondeg. That waiver requires a demonstration of technical feasibility (no aquifer that is amenable to injection), economic feasibility (cost of injection precludes making a reasonable profit), and environmental feasibility (reinjection would degrade ground water). If the waiver is approved and the water meets nondeg, it can be discharged to surface water. Otherwise, it requires treatment prior to discharge. He distinguished reinjection (placing the water back into the same formation from which it was produced) from injection (placing the water into a different aquifer). The proposed rulemaking primarily looks at reinjection, recognizing there are limitations to injection.

Most companies will probably apply for a waiver initially because reinjection is not possible until coal seams are depleted. Over the long term, however, 50-75% of the produced water may be reinjected. The key benefit of reinjection is that it avoids groundwater drawdown and eliminates surface water treatment discharge and disposal issues. Wyoming is only reinjecting about 2% if its produced water because it is not hardly regulating discharges at all. The cost estimates provided by industry to the EPA are all over the place, ranging from less than $100,000 to a million per well and operating costs from 10 cents to $2.25.

Reverse osmosis and ion exchange are proven applied technologies and there are a variety of other technologies being developed today. A by-product of treating water by reverse osmosis is a concentrated brine that may be reinjected into the aquifer. The operating costs are generally 10 cents to 25 cents a barrel; total capital and operating costs are generally less than 50 cents a barrel.

There are impacts associated with land application and evaporation. Evaporation results in the loss of water that is then not available for beneficial use. Land application and evaporation also may result in unintended discharges to surface waters. Land application may result in impacts to soils and plants. The cost of reclaiming SAR damaged soils may be as high as $100,000 an acre. Considering the costs of production, reinjection and treatment, it will cost industry approximately $1.95 to 2.25 per MCF. The price of gas is not likely to go below $4. Therefore, industry will still be able to make a very, very large return on investment.

Mr. Kuipers noted Montana's experience with extractive industries going bankrupt, requiring good reclamation plans and financial assurance to fund the reclamation. There are not good reclamation planning statutes for CBM activity. The proposed rulemaking goes a long way in addressing reclamation and financial assurance liabilities.

Mr. Kuipers submitted a paper copy of his power point presentation.

Opponents

John Veil is with Argonne National Laboratory, a large research organization. He previously worked with Maryland state agencies writing and reviewing NPDES permits and had management authority for the underground injection control and oil control programs.
The proposed rulemaking inconsistently characterizes CBM produced water as wastewater having some constituents that are hazardous parameters while also acknowledging the water has value both in quality and quantity.

The proposed rulemaking does not follow CWA guidelines for establishing technology-based limits. Even if zero discharge is agreed to be the acceptable end point, the rules should not force the use of only one technology (reinjection) when there are other ways to achieve zero discharge.

The proposed rules give no detailed rationale for the selected numeric limits. Numeric limits that represent BAT should not reflect best possible treatment under ideal conditions. Rather, they are intended to reflect long-term performance under actual industrial conditions.

The effluent limits in the proposed rulemaking are much stricter than necessary to meet water quality standards.

The proposed rulemaking calls for minimum technology-based effluent limits when it should provide maximum limits.

Several parameters in the proposed rulemaking are expressed as a range. As a result, one would be out of compliance on the lower and upper end.

The proposed numeric limits for sodium, calcium and magnesium will result in a value of SAR that is several times higher than the limit proposed for SAR.

There is nothing inherently harmful about EC and SAR --- they are only measures of the property of water. Only the magnitude of these properties presents problems.

There are very few geologic formations in Montana suitable for reinjection in shallow zones where the water could later be recovered.

The proposed rulemaking includes a cumbersome waiver process. It will be expensive to compile the large amount of information required. Because there are few suitable geologic formations, the waiver exception may end up being the general rule.

The technologies identified to meet the proposed effluent limits (reverse osmosis and ion exchange) haven't been used extensively in CBM development. There is no data that the proposed numeric limits can be met consistently across the entire range of CBM waters found in the region.

The proposed standard for arsenic is 100 times lower than the current standard and cannot be measured by current monitoring technology.

Reverse osmosis and ion exchange both produce a semi-solid waste stream, the disposal of which raises additional issues.

Mr. Veil also submitted his testimony in writing.

Brian Cebull is the manager of reservoir engineering and technology for Nance Petroleum headquartered in Billings. Nance Petroleum has grown to 78 full-time employees and has a $6.2 million pay roll. The proposed rulemaking would negatively impact Nance Petroleum's ability to develop CBM resources in Montana.

While the primary goal of the Hanging Woman Basin Project is off-channel infiltration, Nance Petroleum has experimented with reinjection at the project. It has found that sandstones in the Powder River Basin are generally laterally discontinuous channel sands and lenticular sands and very difficult to predict. One reinjection well was completed in shallow sand at about 136-160 feet. Nance Petroleum was only able to reinject about 250 barrels a day from July to September before the sand became saturated. Another well was completed in deeper sand that was more successful, averaging 1600 barrels a day , which is continuing. So reinjection can work, but it is not a suitable lead-in water management tool.

There are also problems with treatment required under the proposed rulemaking. At the Hanging Woman Creek project, there is no good place to take the treated water. The Tongue River is 22 miles away. He sees treatment as an option for a portion of the water. In addition, requiring both reinjection and treatment removes the most important part of the water management equation, and that is the wishes of the surface owner. Reinjection and treatment should be tools in the toolbox, but they shouldn't be the only tools.

Finally, he expressed concern about the length of time it may require for a CBM developer to obtain an exemption from the reinjection requirement. It may take 390 days from the submission of the waiver request and a minimum of two and one third years from the actual start of the project to get a waiver. A prudent CBM developer is not willing to take this kind of timing risk.

Mr. Cebull submitted a written summary of his testimony and a paper copy of his power point presentation.

Bill Schafer has a Ph.D. in soil science. Early in his career, he worked as an extension soil scientist in the areas of saline and sodic soil management and irrigation water quality. He discussed the scientific basis for the current rules, which he believes are too conservative. Electric conductivity affects crops. Alfalfa is the most sensitive crop. A lot of literature suggests

that the threshold salinity should be around 2,000 --- a more recent study at the Bridger plants material center showed that salinity threshold in the soil of 4,000 is protective for irrigation of alfalfa. Because the soil salinity is typically higher than the irrigation water salinity, a safe level of irrigation water salinity is 2,600. The current standards are 1,000 – 1,500 on the Tongue River and somewhat higher on the Powder. The sodium adsorption ratio affects soils. A safe level of SAR in irrigation water depends on the clay mineralogy of the soils. That safe level is about 8. According to the Hanson chart, the ambient quality of the of the Tongue River always meets the standards and has a tremendous assimilative capacity, indicating the current standards are conservative and perhaps set lower than can be scientifically supported. The median EC and median SAR of the Tongue River is similar or less than those values for the Yellowstone, Missouri, Milk and Big Horn rivers. Although the Powder River has much higher salinity, it is not at risk because of the SAR and substantial increases in the SAR would still not create a risk of permeability problems using the existing standards.

He also described the current water quality in the Tongue and Powder rivers. EC's run about 600-800 throughout the river, meeting standards throughout its entire reach. There is no discernable change in the relationship between flow and EC and between flow and SAR when comparing data that was collected before and after CBM development began in 1999. The problems with water quality in Miles City are unrelated to CBM development 66 miles upstream. It is probably a result of most of the water in the Tongue being diverted, leaving an appreciable amount of the remaining flow in the Tongue River coming from Pumpkin Creek, which is known to have much higher EC and SAR.

The Powder River is more of a prairie-dominated river having higher average salinity and higher average SAR level. There is no discernable change in the relationship between flow and EC when comparing data that was collected before and after CBM development. While there appears to be an increase in SAR at a particular flow level, it is not due to CBM development.

Changing the nondegradation rules is equivalent to reducing the standard by 50%. If standards are reduced by 50%, the existing conditions in the Tongue River are above standards virtually all the time. This may cause problems in the future with industry, any new dischargers that may want to discharge water to the river, publicly owned treatment works such as the city of Sheridan, and perhaps irrigation return flows.

Neal Fehringer is a certified agronomist and crop advisor for the American Society of Agronomy. The Agronomic Monitoring and Protection Program looks at soils and crops to monitor the effects of discharges. The Program has fourteen locations along the Tongue River --- ten irrigated with Tongue River water, two irrigated with tributary water and two dry land -- each which were paired with the exact same soil series as an irrigated one to see the effects of irrigation over time. They conducted sampling in the fall of 2003, spring of 2004 and fall of 2004. Over these three sampling periods, there was no change in EC, SAR, or exchangeable sodium percentage (ESP).
He has also worked with companies that are engaged in managed irrigation. The goal is to keep SAR's below ten, which they are doing with the addition of gypsum and disintegrating sulpher. They've had a 73% decrease on the gypsum fields in the zero to six inch layer since 2002. Right

now the SAR's are sitting in the six to 24 inch layer, but should move down with more precipitation.

John Corra is the Director of the Wyoming Department of Environmental Quality. The classification of EC and SAR from non-significant to hazardous is unnecessary. Wyoming has a lot of experience, regulating 550 million barrels of water a year through about 930 coal bed methane permits. Wyoming is very careful to meet Montana's standards and there is no evidence of degradation at the border. Wyoming is also working on watershed based permitting, allowing a more proactive planning mechanism. Wyoming also permits water treatment plants and land application. Wyoming also conducts a lot of monitoring; the streams running into Montana are among the most monitored in the country. On the Powder River, Wyoming contains all discharges or treats discharges to ensure Montana standards are not violated at the border. On the Little Powder, Wyoming contains and manages flow to certain parameters. The water in the Little Powder can be improved with the addition of CBM discharges. On the Tongue River, there is containment, allowances for discharges during storm events, and some direct discharges with treatment to Montana standards.

Wyoming has worked very closely with Montana on this issue. In 2001, Wyoming committed to no measurable change in parameters of concern until more information was obtained. Wyoming has worked hard to define baseline and current conditions in the rivers, and both states support a comprehensive monitoring program. Both states have also had discussions on a structured approach to managing water quality in the assimilative capacity.

The existing rules are sufficient. Damming conditions often exceed the standards in the Powder and Little Powder rivers. The Tongue River standards are overly conservative. When you put a nondegradation component on top of the already conservative standards, you take that down to where there is no usable capacity in the rivers --- the ambient conditions are almost always in exceedence. The proposed rulemaking is unfair because it places a disproportionate burden on point source discharges and will severely limit Wyoming and Montana from being able to do their job under the Clean Water Act. The proposed rulemaking also circumvents the TMDL process, places an unfair burden on Wyoming and negates Montana and Wyoming's collaborative effort.

Mr. Corra also submitted his testimony in writing as well as a paper copy of his power point presentation.

Tom Osborne is the principal hydrologist for HydroSolutions. The hydrology of the Fort Union formation is not conducive to large-scale injection. While the coal seams are relatively traceable and continuous, there are not the relatively continuous formations with good porosity and permeability that are needed to make injection work. The sandstones are discontinuous. Injection works in the San Juan River Basin because only about 25 barrels of water per day is produced per well, compared to the 400 barrels per day in the Powder River Basin. Additionally, it has thick continuous sandstone beds.
There are also practical limitations to injecting into already produced coal seams. There are presently few opportunities as the oldest production in Montana is only five years. There are serious legal implications to piping the water to another's leased area and objections would be

raised by nearby mineral holders that are not even producing yet. Coal mines may also be adversely affected by water being injected into nearby wells. The successful reinjection program near Gillette is unique because the city of Gillette had dewatered the coal, providing an opportunity for reinjection to occur.

He also asserted inaccuracies in the Petitioners' model. The model shows a well producing from a shallow coal that then runs over to a stream valley. This situation almost never occurs. CBM production almost never occurs in coal seams that are close to outcrops. Petitioners' injection model shows injection into shallow coal --- that would not be permittable. Only about 1.2 to 2.2 percent of produced water is reinjected in the Powder River Basin in Wyoming.

There would be a one-to-one ratio of the number of reinjection wells drilled to the number of production wells because some reinjection wells would be drilled and not usable. Every successful reinjection well could inject water from two production wells at the initial rate of water production.

The proposed rules are not needed. The effect of CBM production on shallow aquifers will be quite limited. Less than 10% of the private wells are greater than 300 feet and less than 10 percent of the coal bed wells are less than 300 feet, so the overlap is small and is dealt with by the present rules. The DNRC has a controlled groundwater area that requires mitigation agreements out to a mile and they're extended another half mile if there is an effect. The wells that may be impacted are identified in the environmental assessment prepared prior to the development of a particular area. Mandatory injection would lead to water surface disturbance, would force deep injection and limit some of the beneficial uses of produced water.

Mr. Osborne submitted a paper copy of his power point presentation.

Bob Kimball works for CDM as a chemical engineer specializing in the development and application of advanced treatment technologies to help solve industrial wastewater management treatment issues. He was responsible for the chemical evaluation and development of ion exchange and reverse osmosis treatment technologies. He discussed whether the proposed new treatment limits are feasible from an economic, technical and environmental perspective.

Reverse osmosis involves the moving of produced water of high pressures through a semi-permeable membrane that is capable of removing 97-99% of all dissolved ions in solution. The technology creates a treated water stream and a brine concentrate. To avoid membrane fouling, the produced water is pretreated by the addition of either acids or anti-schements followed by a cartridge filtration system. The brine concentrate is the single greatest cost factor and issue. It will have dissolved solids ten times the concentration of the produced feed water.

Similarly, ion exchange removes dissolved ions from the solution. There is sodium bicarbonate in the produced water. An ion/anion exchange resin absorbs the sodium, releases a hydrogen ion, which reacts with the bicarbonate. It does not remove any of the anions such as chloride or sodium. Like reverse osmosis, ion exchange produces a treated water stream and a brine concentrate.
Reverse osmosis and ion exchange are probably the only viable treatment technologies. Both are considered advanced treatment technologies, requiring a high level of design and operating

experience. Both produce a waste brine solution that requires management and disposal. Both require chemical addition. Both performance parameters are predictable.

CDM reviewed a document produced by NPRC indicating that reverse osmosis was an affordable technology. The document underestimates the cost by 240% because it did not consider the cost of reverse osmosis pretreatment, equipment installations and indirect costs and miscalculated the cost of brine disposal. The document also used an incorrect water to gas ratio causing a cost estimate 270% below the actual cost. The combined effect is that the estimated cost is low by 650%. He hasn't seen what the costs would be to meet the proposed new treatment.

The proposed effluent limits are not practically achievable. The discharge limits appear untrue and without scientific basis. An effluent that meets the proposed limits for calcium, magnesium and sodium will exceed the proposed SAR limit by a factor of five. Meeting the proposed limits for calcium, magnesium and arsenic is not feasible or proven in the current and available technologies. The arsenic limit is .1 parts per billion --- ten times below the detection limit.

The only treatment system that would work would treat the produced water twice using reverse osmosis. The cost to meet the proposed limits using dual treatment systems was not considered in the NPRC document.

In terms of environmental feasibility, there has been no indication what is going to be done with the concentrated brine that needs disposal. That is one of the greatest costs faced by industry and its environmental impacts have not been established. The brine can be disposed of by injection, evaporation ponds or commercial disposal. There is limited ability for injection in the Powder River Basin. A typical 250-gallon per minute treatment facility would need a17.5 acre pond and require a lining pump, monitoring wells and closure at the end of the project including removal of the salt and long-term disposal of the salt in a landfill. Commercial disposal is the most feasible. A typical 250-gallon per minute treatment facility would require sixty-three 4,000 gallon tanker truckloads a week to haul the waste to the disposal well. The impacts from hauling brine need to be considered. It would be a nightmare if this were mandated region-wide.

Chemical hauling is another concern. A typical 250-gallon per minute reverse osmosis treatment facility would require one 4,000 gallon tanker truck of 32% hydrochloric acid a week to support the operation. An ion exchange treatment facility would require twice that amount.

He hasn't seen accurate or reliable data indicating that treatment is chemically feasible or affordable to meet the proposed limits. The environmental impacts of brine disposal have not been addressed.

In response to a question, Mr. Kimball indicated that actual cost would be 60 to 70 cents a gallon, but that didn't include the total economic factor associated with the entire operation.

Mr. Kimball submitted a paper copy of his power point presentation.
Dave Searle is the Environmental Safety Manager for Marathon Oil Company. Its subsidiary, Pinnacle Energy, operates about 1800 wells in the basin with an average daily production of 83.5

million cubic feet of gas, enough to supply the energy needs for about 376,000 homes. Nothing has changed since reaching decisions a couple years ago on numeric standards, nondegradation, flow based standards and severability. These standards are working and, to some, are overly protective.

Pinnacle has drilled 24 injection wells into sands over the past years. Ten have been successful in the sense that water is able to be injected. Nine of the wells are still operating and are injecting a total of 311 gallons per minute. The amount of water that each well is injecting ranges from 127 gallons to two gallons per minute. Pinnacle has evaluated injection at a lot of other projects and it is very, very difficult to find a place that is suitable for injection.

The water that comes to the surface is a valuable commodity. Pinnacle produces gas, but it also produces water. Ninety-five percent of the landowners they work with want the water. Water injection does come with an environmental cost. Drilling the injection wells and construction of roads and power lines result in additional surface disturbance. He estimates that they may have to drill as many as 75 injection wells, some of which would not be successful, to dispose of the water from 50 production wells.

In regard to treatment, an engineering company conducted a full-scale project demonstration test. The results sent Pinnacle back to the drawing board to some degree. The technology is short of being able to be commercialized but will continue to advance. Pinnacle's goal is water quality at the end of the pipe that are based on current standards and that meet Montana's water quality standards at Stateline. The standards in the proposed rulemaking, both in terms of nondeg and end of pipe standards, are not going to be reachable by current technology.

A lot of Pinnacle's operations are some distance from a stream. What is the operation to do with the water after it is treated?

Wyoming is not making environmental sacrifices for the economic impact of CBM development. The handling of water is regulated by quality, quantity, water rights, reservoir construction and location permits administered by Wyoming DEQ in a very conservative manner.

He feels the rulemaking pits irrigated agriculture against energy. Pinnacle doesn't want to degrade irrigated agriculture. Pinnacle will do what is necessary to protect irrigated agriculture and the standards currently in place have been very successful. The proposed rulemaking will penalize the agricultural community that relies on produced water for cattle raising operations.

The injection project near Gillette that has been described as successful is operated by Pinnacle. The wells inject water in lower Fort Union sands that have been drawn down to provide drinking water for Gillette. Pinnacle ran a 40 production well project using two injection wells. A very successful project, but very unique.

He also indicated the limited ability to use production wells for injection. The water equilibrates around the well bore and the coal seams recharge up to 80% of the original water table in the first four to five years. There is not a completely empty tank to fill.

Kevin Harvey is a board certified soil scientist and manages KC Harvey, LLC. KC Harvey is a firm of soil and water resource specialists performing reclamation and water management for

industry and also work for land management and regulatory agencies. It doesn't cost $100,000 to reclaim an acre of sodic land. He has reclaimed very difficult highly sodic soil in Wyoming for $2000 an acre.

Managed irrigation is one of several beneficial uses relied on to manage produced water in the oil and gas industry. Mr. Harvey coined the term "managed irrigation" to differentiate agronomic irrigation using produced water to grow crops from conventional wastewater land application projects.

Consent of the landowner is a key component of managed irrigation along with suitability of the site and soil, chemistry of the water, the water balance, crop selection and site closure.

The initial rulemaking application inaccurately stated that Fidelity applied 105 inches of water to a site. Water is applied at agronomic rates to meet the needs of the crop. Alfalfa requires about 33 inches of water per season. An additional leaching requirement of five inches is required for a total agronomic rate of about 37 inches. The leaching fraction is the part of actual precipitation and irrigation that reaches below the root zone and assures that salts do not accumulate in the root zone.

Mr. Harvey showed slides of the Tongue River West Managed Irrigation Site that went from supporting cheat grass, prickly pear and crested wheat grass to supporting a second cutting of alfalfa, the 7 Brothers Ranches managed irrigation site, and the Tongue River East managed irrigation site.

It is relatively simple to put the managed irrigation site back into a native plant community. The sodicity of the soil may be adjusted downward and Mother Nature may be allowed to leach whatever salts are on the surface, which are not extraordinarily high. The irrigation equipment is usually left with the landowner.

Mr. Harvey submitted a paper copy of his powerpoint presentation as well as photographs of managed irrigation at Tongue River West and East and 7 Brothers Ranches.

Jimmy Goolsby is a managing member of the geologic consulting firm Goolsby & Associates and has worked in the Powder River Basin for the last thirty years. He has spent a lot of time looking for places to inject water in the Powder River Basin. You can't find good places that will accept water at reasonable rates.

Yates Petroleum had drilled an injection well 14,000 feet deep at a cost of $5 million and it is not at a stage where they can tell if it will be successful. If it is, they will drill three more wells and then have the capacity to reinject approximately 25% of their produced water. It's a tremendous expense that can only be done at $10-11 dollar gas.

To put things in perspective, he related that his farm in Texas had irrigation well that would pump 1000 gallons a minute and would be used to irrigate 15 acres a day. Fifty of those wells would produce more water than all the wells in the Powder River Basin. The groundwater produced in the Powder River Basin is roughly equivalent to the evaporation off Seminoe, Pathfinder and Alcova Reservoirs. The Powder River Basin in Wyoming contains about 25 TCF

--- the same amount of gas as produced out of the Gulf of Mexico. The Montana portion has about 3 TCF.

Joe Olson is the Facilities Engineering Manager for Williams Production RFT Company in Gillette, Wyoming. Williams Production is currently the largest CBM producer in the Powder River Basin holding 143 NPDES permits with 500 outfalls, four directly to the Powder River. It does not have any production along the Tongue River.

Since Montana set standards in 2003, Williams Production has conducted extensive modeling and monitoring efforts to define the assimilative capacity of the Powder River to effectively manage discharges. Wyoming has participated in a cooperative effort to protect the standards Montana passed in 2003, although many feel they are overly protective.

If the proposed rulemaking is implemented, particularly the nondeg provisions, it would cause Williams Production extreme delay in projects that are already nearly coming to the point of execution. Additionally, there are some projects that wouldn't be completed.

Williams Production has conducted extensive monitoring in regard to a permit that allows direct discharge into the Powder River and also participates in a main stem monitoring program initiated by Lance Oil and Gas involving nine monitoring locations along the river. The monitoring shows that there has been no impact to the quality of the water that can be discerned and that there is assimilative capacity. There is no need for additional regulation and the nondeg provisions of the proposed rulemaking would cast an undue burden on Wyoming and on operators in the region.

Pete Schoonmaker is the CEO of Pinnacle Gas Resources. He also runs several thousand cattle on a ranch in Laramie, Wyoming, and brings his outlook as a rancher into his leadership of Pinnacle. Pinnacle's mission is to create better communities while taking gas from the ground, considering the quality of life, what it means to be environmentally friendly, how to create energy security, how to stimulate economic development. etc. While he recognizes that personal and social factors may inform the decision making process, he hopes science will carry the day.

Pinnacle believes that reinjection is one of the tools that can be used to manage water. Reinjection, however, is the least reliable tool in the tool kit and it would be a mistake to require reinjection as a first option. The Board should not mandate a particular method of doing business. The better approach is to keep the existing standards and let industry figure out how to meet them. Mr. Schoonmaker also submitted his testimony in writing.

Keith Reeves is the geology manager for Pinnacle Gas Resources. Pinnacle is currently treating and discharging water under a permit issued under the current guidelines. The treatment plant handles wastewater from 8 to 12 producing wells. A typical power operation would be approximately 24 wells, requiring essentially two plants of the scope and scale of the one presently being operated. The current plans of development provide for 250 wells, which would require approximately 20 to 30 plants. This is a non-water quality impact that needs to be considered.

Pinnacle monitors water chemistry both upstream and downstream of its discharge point. A comparison of the monitoring data indicates effectively no change in the chemistry as a result of its discharge of treated water.

Pinnacle is continuing to examine injection/reinjection as an alternative. They drilled two wells into a 60 foot sand formation that is typical of sand formations in the area. Pinnacle attempted to inject water in the first well at 400 pounds per square inch with no success. In the second well, two attempts to inject the water into the sand formation at 750 pound per square inch were not successful. While injection is not impossible, it is quite difficult and unpredictable. They also drilled two core wells in Big Horn County for a total of 1,744 feet of core and did not find a suitable injection horizon.

He estimated that at each production location, Pinnacle would have to drill four wells per location to dispose of the water produced by the production wells, resulting in a significant increase in surface impact.

Phased development – depleting coals in one area and moving to the next area, producing the coals in those areas, and moving the water back to where it was depleted – is the sequence of production occurring in Montana. The coal bed production technique starts at the edges of the basin and works inward. If the phased development were applied, the sequential completion of production areas will move down depth. If water would be taken and placed in zones that had been completed, Pinnacle would be taking water and dumping it on its own head. Reinjection is not a viable alternative.

In addition, phased development does not take ownership into consideration. Fidelity is the only operator that has produced in the state for a significant period and would not be receptive to Pinnacle putting its produced water in Fidelity's wells.

Finally, Mr. Reeves explained that CBM production requires only the depressurization of coals, not the dewatering of coals. Water is removed to a point where the potentiometric pressures are sufficiently lowered to release the gas and water is continued to be removed to keep the pressure at a certain level. This process does not necessarily create an empty glass in which to put the new water.

Mr. Reeves also submitted his testimony in writing.

Bruce Williams is a petroleum engineer and was hired as Vice President of Operations for Fidelity's predecessor company and was charged with developing CBM gas in the western portion of the Powder River Basin in Wyoming. He believes that Fidelity is producing gas responsibly. Fidelity has mimicked USGS monitoring on the Tongue River, set new standards with its landowner relations, and funded scientists to establish a program to understand soil and crop characteristics. Fidelity has conducted cutting edge agricultural practices of developing managed irrigation, turning produced water into a real plus. Fidelity paid for a new gauging station on the Tongue River upstream of the T&Y Diversion. Fidelity has looked at injection and has proposed treatment in Montana that is pending permit approval.

The EPA, the Board of Oil and Gas, and the Clean Water Act are not going to allow the reinjection of brine because it would be injecting dirtier water into cleaner water.

Water can be treated to reasonable standards. But if the calcium, magnesium and sodium standards of the proposed ruled making are adopted, the SAR standard cannot be met. It is very difficult to meet the standard for arsenic in the proposed rulemaking because it is below detection limits.

In response to the comment that the waiver in the proposed rulemaking was similar to a nondeg waiver, Mr. Williams indicated that a nondeg waiver has never been sought or achieved in Montana.

The proposed rulemaking is a way to slow down and stop development. The data doesn't suggest there is a problem with the current standards.

Jeffrey Jones is Vice President of Operations of Lance Oil and Gas, which is very active in CBM development. One hundred and twenty families make their livelihood working for the company producing gas and generating water that will be going down the Powder River.

Mr. Jones discussed what happens to wells that are starting to deplete. Some wells were built in 1995 and are about three years from depletion. It's not yet time to start reinjecting into off site wells. That would be a loss of resource in violation of Wyoming's conservation laws.

Lance Oil and Gas reinjects at San Juan. There you drill an injection well into a huge aquifer where there's plenty of room for the water to expand into adjacent shales. Lance Oil and Gas can drill one injection well for every 50 CBM wells. Lance Oil and Gas produces close to a billion barrels of water in Wyoming and there simply aren't formations that will accept water, except in very unique situations.

Intermittent production and injection into the same well will not work. Phased development is an interesting concept. Lance Oil and Gas has not had the opportunity to reinject under the concept of phased development because it doesn't have any depleted zones but will do reinjection when the opportunity presents itself. Injection isn't really viable but reinjection may work.

He doesn't believe that there is off-the-shelf technology that will meet the proposed standards. The water that is currently being released right next to the Powder River is being treated. It's a challenge to treat the water to meet current standards. The technology is not straightforward and it always costs more than what everybody thinks. If the standards are cut --- not in half or in third but to the proposed standards --- its staggering to think what that is going to cost. The proposed standards exceed the drinking water in most cities in this country.

Lance Oil and Gas treats water for use in irrigation. That is a much better beneficial use than injecting the water into a deep aquifer where it will never be put to use.

Bill Courtney represents Quaneco, LLC., a partner with Pinnacle on projects around Broadus and the Tongue River. He was involved in obtaining the Pinnacle's permit. The permitting process took almost two years and that was during the time the numeric standards were being proposed.

Mr. Courtney also read the following from a report being prepared by Intermountain Labs.

> New Rule VIII A, B, and C will be in compliance with the proposed numeric standards for calcium, magnesium, and sodium, the calculated SAR value will exceed the proposed numeric standard for SAR of .5. Using the median values for proposed standards for calcium, magnesium and sodium, the corresponding SAR calculation is 3.2, six times more that the proposed standard for SAR. The proposed numeric standard for calcium .1 to .2 milligrams per liter is 250 to 500 times less than the two year – ten-oh-three to ten-oh-five average ambient concentration of 53 milligrams per liter on the Tongue River at the Wyoming/Montana state line.
>
> The proposed numeric standard for magnesium, .1 to .6 milligrams per liter, is 50 to 300 times less than the two year ten-oh-three to ten-oh-five average, and in concentration of 31 milligrams per liter on the Tongue Rive at the Wyoming/Montana state line; the proposed numeric standards for arsenic, .0001 milligrams per liter, is 100 times less than the new federal EPA drinking water standards for arsenic, or .01 milligrams per liter effective January 2006.

The proposed rule for arsenic is not achievable.

Chairman Russell then closed the public comment portion of the meeting. The BER invited and received no public comments on matters that did not pertain to CBM development. The meeting was then adjourned.

Submitted Written Comments

Charlotte Kress (Proponent) is from Missoula. There is no question about the value and need for clean water. The amount of water in eastern Montana is very limited and if the methane water is not managed correctly, the livelihood of hundreds of farmers will be jeopardized. It is practical and affordable to return produced water to the aquifer. Where that is not possible, the produced water can be economically treated and discharged in streams or used to irrigate.

Richard Robitaille (Opponent) is the Rocky Mountain area manager of government relations from Anadarko Petroleum Corporation. Anadarko is an oil and gas exploration and production company with operations in Montana and Wyoming.

Anadarko manages CBM produced water a number of ways. Produced water is discharged to the surface and is readily assimilated into the Powder River during all levels of river flow. The flow of produced water is assimilated within about 20 feet during high flow and a quarter of a mile during low or zero flow such that SAR and total dissolved solids are at background levels. Some of the produced water is discharged to impoundments where it evaporates, infiltrates and is used by wildlife, vegetation and livestock. Some of the produced water is used for irrigation. The soil is amended and the resulting barley and alfalfa crops are used by wildlife and cattle. In

Anadarko's area of the Powder River Basin, the produced water cannot be injected because the formations are shallow, discontinuous, small and/or "tight." Anadarko is constructing a 50 mile pipeline in order to inject near Midwest, Wyoming. This situation is unique. Some treatment of produced water is not uncommon. Enhanced aeration is used to equilibrate the water to surface conditions. Gypsum and zeolite adsorption enhanced treatment systems are also used. CBM produced water has SARs varying from 10 to 50. Soils in Wyoming and Montana will typically tolerate less than 11 SAR. Ion exchange and reverse osmosis can generate wastes up to 15% of the original water volume and presents problems in disposing of the wastes.

Mandated injection fails to recognize opportunities for beneficial use and assumes the application of unproven technology.

Monica Yetter (Opponent) is from Laramie. She submitted a DVD of a public forum held in Miles City were Wyoming ranchers presented their real-life experiences with CBM development.

CBM water in its unaltered state usually meets or exceeds Wyoming and Montana surface water quality standards. Every well must be permitted as a gas well (Wyoming Oil and gas Conservation Commission or the Bureau of Land Management, and the State Engineer's Office) and a water well (Wyoming DEQ). Where it won't meet standards, Wyoming DEQ won't issue a permit. If a permitted well comes out of compliance, the company is required to submit a compliance plan to Wyoming DEQ.

In Montana, the Board of Oil and Gas Conservation has oversight of CBM produced water being discharged into pits or impoundments. If the produced water is to be put to beneficial use, a beneficial use permit must be obtained from the Department of Natural Resources. If it is to be discharged, a NPDES permit is required form DEQ. Montana has recently adopted numeric standards for SAR and salinity for the Tongue and Powder Rivers and Rosebud Creek. Produced water will be sent to agreed-upon management sites. Most water may be discharged into drainages including off-channel reservoirs, in-channel ponds and stock tanks. The reservoir may be lined with plastic or clay to prevent seepage into the ground. Soil and water amendments may be required if the produced water is used for irrigation. The addition of gypsum and sulfur is currently being practiced with success.

Ms. Yetter also submitted photographs of the Carlton Dewey Ranch showing CBM produced water being put to beneficial use and other photographs depicting CBM development.

Board of Environmental Review November 9 and 10, 2005, hearings summary approved:

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JOSEPH W. RUSSELL, M.P.H.
CHAIRMAN
BOARD OF ENVIRONMENTAL REVIEW

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DATE